



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

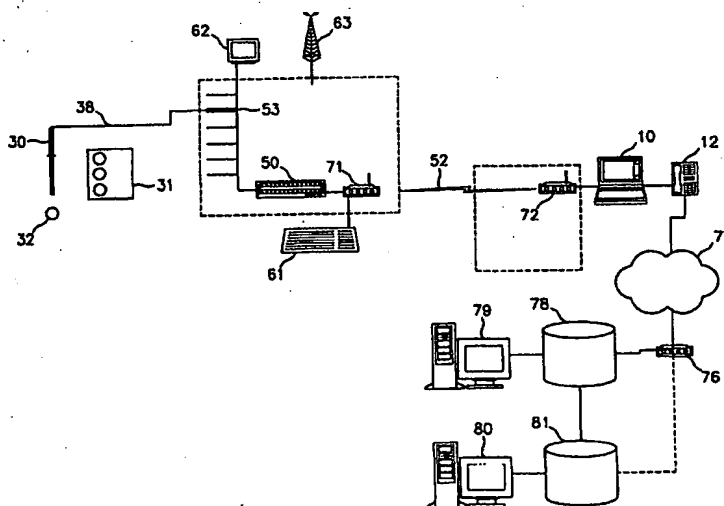
(51) International Patent Classification <sup>6</sup> : <b>A01K 11/00</b>	<b>A1</b>	(11) International Publication Number: <b>WO 99/45761</b>
		(43) International Publication Date: 16 September 1999 (16.09.99)

(21) International Application Number: PCT/US99/05122

(22) International Filing Date: 8 March 1999 (08.03.99)

(30) Priority Data:  
09/036,564 9 March 1998 (09.03.98) US(71)(72) Applicants and Inventors: PAPE, William, R. [US/US];  
256 Highway 95, Los Ojos, NM 87551 (US). CURK-  
ENDALL, Leland, D. [US/US]; 1806 Sunlight Drive, Long-  
mont, CO 80501 (US).(74) Agent: YEAGER, Rick, B.; Suite 3C, 12343 Hymeadow,  
Austin, TX 78750 (US).(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR,  
BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD,  
GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP,  
KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK,  
MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG,  
SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW,  
ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG,  
ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ,  
TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI,  
FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent  
(BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE,  
SN, TD, TG).**Published***With international search report.*

(54) Title: METHOD AND APPARATUS FOR LIVESTOCK DATA COLLECTION AND MANAGEMENT SYSTEM



## (57) Abstract

An efficient method and apparatus for livestock data collection and management is described to provide quality assurance source verification data and performance tracking for individual animals throughout the production cycle. The preferred embodiment includes unique radio frequency identification (RFID) transponders for each animal; unique RFID transponders for animal events; default event data capability; a portable and wireless RFID reader to read the animal and event transponders; a multiple input/output device to accept the reader signals and livestock measurement data and to communicate by means of a wireless radio communication to a host computer; a feedback means from the host computer to acknowledge receipt of data; BeefLink™ software to provide data gathering, storage, and query support, and a protocol converter to facilitate the transfer and sharing of data between different livestock databases.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

**METHOD AND APPARATUS FOR A LIVESTOCK DATA COLLECTION  
AND MANAGEMENT SYSTEM**

5

**Background--Field of Invention**

This invention relates to a method and apparatus for enabling an integrated electronic system for tracking processing events for a meat animal from its conception to its consumption, by using data entry devices that minimize keyboard entry and by using multiple interconnected databases such that a particular animal history can provide both quality assurance source verification and performance tracking.

10

**Background--Description of Prior Art**

15 Overview

There is a need, for both economic and quality assurance reasons, for an efficient and cost-effective method for identifying and tracking livestock, and for the monitoring of the processing of those livestock. Throughout the livestock production and processing cycle, there is a need for more detailed information so that ranchers, stockmen, feedlots, packers, distributors and retailers can make informed decisions about factors and variables such as genetics, herd management, purchasing, feed strategies, and ship dates. Producers who improve their animal performance can realize greater returns with performance based compensation when accurate information about the history and the value of each animal is easily available.

20

There is also a growing concern about quality assurance in the livestock processing cycle; and there is an opportunity for producers and processors who can establish that quality assurance to improve their compensation. Effective quality assurance programs such as HACCP, or Hazards Analysis and Critical Control Points, programs require accurate and  
5 timely information about the history of each animal.

### The Beef Industry

The beef industry is a good example of the livestock industry. Traditionally, there are four segments to the U.S. beef industry: the cow/calf producer, the stockman, the feedlot, and the packer.

10 The commercial cow/calf producer has a herd of mother cows that are used to produce calves. The cows are bred to bulls so that, ideally, each cow has a new calf each year. The calf crop that is produced each year is used primarily for meat production, with some calves retained as replacements for the herd. The calves are usually weaned from their mothers at between six and eight months of age. The traditional producer will sell his  
15 animals once they are weaned. Typically, the main objectives of the producer are to have a calf from each cow each year; to have healthy, vigorous calves with the highest weaning weights at the lowest cost; and to produce the best meat, by factors such as tenderness and taste, at the lowest cost.

In order to support these objectives, the producer is interested in efficient systems for  
20 identifying and tracking individual animals as they rotate through the producer's pastures; identifying which animals have a good calving history; monitoring the performance of various pastures; recording calf birth date and birth weight statistics and tracking the genetic history of each animal; evaluating the performance of calves from particular cows or bulls; recording

the weaning date and weaning weight of each animal; and recording treatments, vaccinations, and other significant or events that have occurred in the animal's life.

The stockman receives the weaned calves when they weigh approximately 500 pounds, and feeds them for four to six months until they weigh 700 to 800 pounds. The stockman's typical objective is to add weight as fast as possible, while keeping the animals healthy. In order to support these objectives, the stockman is interested in collecting and using information such as identifying and tracking individual animals as they rotate through the stockman's pastures; recording beginning, ending, and periodic weight measurements and treatments; and recording vaccinations and other significant events that have occurred in the animal's life in order to track of the success of treatments as well as to eliminate duplicate treatments.

After the stockman phase, the animals are typically sent to a feedlot where they are fed a high-energy diet for about 120 days. At the feedlot, the cattle are in a finishing stage, where the main objective is to add pounds quickly while keeping the animals healthy. The cattle will be finished when they reach a weight of approximately 1,100 to 1,200 pounds. The feedlot is interested in animal weight gain, animal health, the effectiveness of various feed ration formulations, required waiting periods on shipping animals after drug treatments, and animal origin and history.

The slaughter facility or packer typically slaughters the animal and then chills, ages and cuts the carcass into the various cuts of meat and packs those cuts for shipment to distributors and retailers. The packer also provides grade and yield ratings for the carcass. Important quality factors include the live animal weight, the carcass weight, a chilled weight, and the yield, grade, and quality of the carcass and carcass defects. The information collected by the packer is important to all of the upstream participants, because it allows

them to adjust their management practices based on the actual quality and economic result for each animal. The upstream data is important to the packer because it permits the packer to select animals that produce the results desired by his customers.

Typically, each of these four segments, the cow/calf producer, the stockman, the feedlot, and the packer, have attempted to optimize their own operations, and there has been relatively little emphasis on cooperative optimization efforts. There is a growing recognition across these industry segments, however, that for both quality assurance reasons and for the improvement of the industry in general, it is desirable to attempt improved data collection and data management. An object of the present invention is to provide that improved data collection and data management.

#### Variability and Quality Control

There is variability in individual animal production efficiency and in individual carcass quality characteristics such as weight, frame size, muscling, fat content, marbling, and feed efficiency. This variation is due to a combination of genetic factors and environmental factors such as health and drug treatments, nutrition, and growth history. Many of the genetic and environmental factors can be controlled or managed to improve both quality and economic return on investment if accurate historical information were available throughout the production cycle.

The livestock industry has recognized that certain livestock species and breeds outperform other species during production and processing. The prior art has used data collection systems and statistical analysis of data related to livestock breeds in order to identify higher performance breeds. There is a need to extend this data collection so that individual producers can make informed decisions about individual breeding animals in order to further improve their herds.

Electronic Identification

Although it is possible to use manual identification methods for livestock and to employ manual data entry methods, it is desirable to automate the identification and data entry in order to reduce expense and to improve accuracy of the data. These devices  
5 typically produce either a unique alphanumeric code or a unique decimal code.

Electronic identification devices and systems have provided a good method for providing identification of livestock. Typically, electronic identification systems utilize a passive electronic identification device that is induced to transmit its identification signal by an externally radiating source. These passive electronic identification devices may be a  
10 transponder carried with the individual animal on a collar as illustrated and described in Carroll U.S. Pat. No. 4,475,481, issued Oct. 9, 1984, entitled "Identification System" and in Kuzara U.S. Pat. No. 4,463,353, issued Jul. 31, 1984, entitled "Animal Feeding and Monitoring System"; in an ear tag such as those commercially available from Destron/Fearing, Inc., Allflex USA, Inc. and Avid Marketing, Inc.; in a transponder  
15 implanted in the animal as illustrated and described in Pollack U.S. Pat. No. 4,854,328, issued Aug. 8, 1989, entitled "Animal Monitoring Telltale and Information System" and in Hanton U.S. Pat. No. 4,262,632, issued Apr. 21, 1981, entitled "Electronic Livestock Identification System"; or in a bolus such as as illustrated and described in U.S. Pat. No. 4,262,632, issued April 12, 1981, entitled "Electronic livestock identification system" by  
20 John P. Hanton and Harley A. Leach.

Although electronic identification through radio frequency identification (RFID) tags or barcodes are used in some phases of the livestock production cycle, there is a need to provide a means for individual animal identification throughout the production cycle and to minimize the difficulty of data entry throughout the industry.

RFID Readers

Several RFID readers are commercially available, typically from the transponder suppliers, including models from Destron/Fearing, Inc., Allflex USA, Inc. and Avid Marketing, Inc.

5       An object of the present invention is to provide an improved reader that supports the objectives of the livestock data collection and management system. The prior art includes RFID readers that can distinguish multiple types of RFID transponders as illustrated and described in U.S. Pat. No. 5,235,326, issued Aug. 10, 1993, "Multi-mode identification system" to Michael L. Beigel, Nathaniel Polish, and Robert E. Malm.

10       This invention features a reader which can recognize multiple types of transponders; that is designed to be hand held in a working chute environment, such that it is rugged and moisture resistant, that has a sealed switch; and that communicate over greater distances to a host computer or data consolidation device. The radio frequency data communications (RFDC) capability of the preferred reader

15       The preferred flashlight shape permits a familiar and convenient object to be held by the user.

      The rigid body permits the reader to be placed into an alleyway, cage, or chute. Some currently available readers offer a relatively, stick-type, RFID antennas that can be placed into a pen or chute, and a cable connecting the antenna to a separate enclosure with a  
20   hand-held or lap-top computer. In these designs, the cable interface to the antenna is typically a weak point which will break down from repeated mechanical strain. The RFDC eliminates cables and, therefore, the physical weak point. It also allows the unit to be a compact, easy-to-handle device without unwieldy cables that tangle and interfere with the user's job. The RFDC communications provide the user improved range and flexibility in the

With the addition of audio feedback, and especially with wireless headphones, the user becomes completely mobile while performing tasks. The user now roam up and down an Alleyway, scanning cows and entering the results of pregnancy checks, scanning steers as they're sorted to various locations, or other tasks.

#### Databases and Management Systems

At different stages of the production cycle, there are different databases, which exist for different business purposes. The rancher will typically maintain his own database, a stockman will have an inventory system, a feedlot will have a management database, and a packer will have its own inventory and management system. There is also a trend toward larger marketing alliance or national databases that include some data from each of these industry segments.

United States Patent No. 5,322,034, which issued June 21, 1994 to Richard L. Willham, for a "Livestock record system" describes a method for storing the individual animal's identification and performance data on a programmable electronic identification and data storage module carried with the animal. An object of the present invention is to provide a low-cost per animal system for obtaining and maintaining source verification and performance databases that are independent of the animal.

United States Patent No. 5,315,505 issued to William C. Pratt on May 24, 1994 for a "Method and system for providing animal health histories and tracking inventory of drugs" describes a method and system for providing improved drug treatment to selected animals in a retained group. A computer system is used to provide an operator with the health and drug treatment history of an animal. With this information and a diagnosis of the animal's health condition, a drug treatment is chosen. The diagnosis and treatment are entered into the

computer system to update the animal's health and treatment history. An object of the present invention is to provide complete source verification and performance databases for all key livestock events.

United States Patent No. 5,673,647 for a "Cattle management method and system",  
5 issued on October 7, 1997 to William C. Pratt, describes an automated method and system for providing individual animal electronic identification, measurement and value based management of cattle in a large cattle feedlot. That method includes individual animal identification, a computer system, and multiple measurements coupled with a cattle handling and sorting system. An object of the Pratt patent was to build a feedlot data base to more  
10 accurately identify and measure characteristics such as weight, so that subsequent animals could be produced and fed for more effective value-based selection and management of the animals. In particular, that database related to calculations for economic management of feeding and shipping to permit optimum weight gains and feedlot ship dates. Whereas the feedlot patent disclosed identifying a particular animal on arrival at the feedlot, an object of  
15 the present invention is to track individual animals throughout the production cycle and to maintain performance and source verification data in the least disruptive manner to existing databases and management systems.

### Objectives

An object of the present invention is to provide an effective data collection and  
20 database management methodology in the livestock industry including automated entry for individual animal identification; automated entry events and of default values for events and data in the processing cycle; and effective communication and sharing of data between the various databases. One result of this data collection and management invention is that quality assurance source verification data for individual animals will be available throughout

the production cycle. This source verification will include the ability to implement HACCP plans. The source verification provides an opportunity for enhanced product value through improved quality assurance and food safety.

Another result of this data collection and management invention is that animal-specific performance information can be provided to the producer, the stockman, and the feedlot, and the packer so that those entities can make informed herd management and operational decisions. Improved information availability permits all segments of the livestock industry to reduce their cost of operations while improving product quality. The opportunities for process improvement range from avoiding duplicate treatments; to selecting more cost effective breeding stock; to selecting more cost effective feeds.

The data collection and management capability is provided in a seamless and non-intrusive manner to all participants. The system encourages the collection and storage of data by putting the majority of the data collection and management process in the background, transparent to the user. Features of the present invention include automated data entry with useful default capabilities for common processing situations, feedback to confirm receipt of data, and the effective integration of multiple databases and inventory or management systems. As part of the production process, other entities, which are not usually in the chain of title to an animal, also have an interest in a portion of the data. Veterinarians can access the health history, nutritionists can access the feed and health history, and bankers can know the location of their collateral. An object of the present invention is to employ authorization levels to designate what information may be made available to these entities.

Through the current invention, the complete history of an animal is equally throughout the production cycle, and both source verification and specific performance

information are accessible without unnecessary duplication of data.

Although the invention is described in the context of beef cattle, it is not so limited. It should be apparent to those skilled in the art that the invention can be modified, without departing from its principles, for other livestock including cattle, swine, sheep, goats, and fowl.

### Description of Figures

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

FIG. 1 is a schematic of a paper information entry embodiment of the information management system.

FIG. 2 is a schematic illustrating a protocol converter to exchange information with an existing livestock management software program.

FIG. 3 is a schematic showing a wired connection between the RFID reader and a host computer.

FIG. 4 is a schematic showing a wireless radio frequency data communication (RFDC) connection between the RFID reader and a host computer.

FIG. 5 is a schematic showing a wireless radio frequency data communication (RFDC) connection to a multiple input/output data concentrator device located between the RFID reader and a host computer.

FIG. 6 is a side view of an RFID/RFDC handheld reader.

FIG. 7 is an internal schematic of an RFID/RFDC handheld reader.

FIG. 8 is an end view of an RFID/RFDC handheld reader.

FIG. 9 is a schematic showing a wireless radio frequency data communication (RFDC) connection between the RFID reader and a host computer and additional livestock databases.

FIG. 10 is a schematic showing a cabled connection between the RFID reader and a data concentrator device and a wireless connection to a host computer and additional livestock  
5 databases.

FIG. 11 is a schematic showing a wireless radio frequency data communication (RFDC) connection between multiple RFID readers and a data concentrator device and a wireless connection to a host computer and additional livestock databases.

FIG. 12 is a schematic of the preferred embodiment.

## 10 Summary

In accordance with the preferred embodiment of the present invention, a method and apparatus for a livestock data collection and management system is described. The objectives of the present invention are to provide an efficient and cost-effective system and method of livestock data collection and data management that will provide quality assurance,  
15 HACCP compliance, and source verification data for individual animals throughout the production cycle. The resulting information will provide a basis for the producer, the stockman, the feedlot, and the packer to make informed herd management and operational decisions. Components of the data collection and management system in the preferred  
20 embodiment include unique Radio Frequency Identification (RFID) transponders for each animal; a portable RFID Reader that can identify the animal transponders; a data concentrator which collects information from multiple measurement equipment or output devices; RF event action tags to automate data entry, preset event data default capability, and data transfer between databases to eliminate duplicate data entry.

**EXAMPLE- WIRELESS COMMUNICATION AND DATA CONSOLIDATION**

In order to better understand the invention, key portions of the invention are described as examples, and larger examples are used to show how the pieces are integrated in the invention.

5 Referring now to Figure 5, an animal is uniquely identified by means of a radio frequency identification (RFID) ear tag 32 or other type of transponder. The preferred identification is an RFID ear tag such as those provided by Destron/Fearing, Inc., Allflex USA, Inc, Avid Marketing, Inc. Alternately, the identification may be by means of an RFID implant, a rumen bolus, or a collar fitting on the neck or leg.

10 This RFID identification is typically applied to young animals at the first opportunity to pen and work the animals, such as at an initial immunization. The RFID identification, typically will have previously been applied to older breeding animals, and will typically remain with the animal until slaughter.

As the animal is typically restrained in a working chute, its identification may be  
15 determined by means of an RFID reader 30. This identification is accomplished by placing the reader near, typically within fifteen centimeters (six inches), of an RFID ear tag or implant transponder. The rumen bolus has a greater range. The preferred reader is described in more detail in an alternative embodiment described below.

Typical events performed on the animal may also be captured without keyboard entry  
20 by means of a Work Card 31 which is a collection of common tasks or events that are assigned unique RFID transponder codes, indicated as transponders 42, 43 and 44, such that the reader can designate an event by reading the transponder associated with an event. This reading is accomplished by placing the reader near the transponder. Alternately, the event transponders can be placed separately at convenient locations in the work area. The event

transponders will typically be labeled with text or symbols to identify the event.

A data concentrator unit 50, which is typically a commercially available, multiple serial port, input/output device is used to collect the reader signal. The reader communicates by means of radio frequency data communications (RFDC) to a radio frequency

5 receiver/transmitter that is connected by serial port 53 to the data concentrator unit. The reader may be connected by direct cable linkage to the port, or preferably, will communicate by radio frequency data communications means 51 from a transmitter/receiver located on the reader to a transmitter/receiver connected to port 53.

The data concentrator may also collect other livestock measurement data through  
10 serial port connections such as a scale 54, a thermometer 55, or an ultrasound measurement device 56. The data concentrator may also be connected to various output devices such as a speaker 57, an LED display 58, a headphone 59, a printer 60, or a UPC Barcode printer or reader 61.

The data concentrator communicates to a computer 10. The preferred  
15 communication is a radio frequency link 52 between a transmitter/receiver attached to the data concentrator and a transmitter/receiver attached to an interface board in the computer. The computer may include a keyboard, a monitor, and a speaker 11. Data may be stored to a diskette 13, but will typically be transferred by means of a modem. The computer is preferably an IBM compatible laptop or desktop computer. Beeflink™ software runs on the  
20 computer to provide the livestock data entry management function. The computer is connected by means of modem 12 to other computers as described more fully in other example embodiments.

This embodiment permits a portable reader to be used in a remote location to gather animal and event data and to communicate that data to a host computer.

## EXAMPLE- RADIO FREQUENCY IDENTIFICATION READER

Figure 6 is a side view of a reading device that is generally referred to as a flashlight reader because the unit is held as a large flashlight would be held. The preferred method of reading animal RFID transponders is with a portable reader such as this device. The reader has an approximate length of 45 centimeters (eighteen inches) so that it can be held by hand outside of a working chute, and the reader may then extend into the chute to reach approximately 12-15 centimeters (5-6 inches) from the animal's ear tag or implant. The reader consists of a generally slightly elliptical body **30**, constructed of a rugged material such as polycarbonate. The body has a handle section **503** of diameter of approximately 3.8-4.5 centimeters (1.5 to 1.8 inches) for the convenient holding of the reader by hand. A relatively larger section **502** is provided in order to house electronic components for the RFID function.

A battery compartment is accessed through a battery door **520** that is sealed by a gasket. The battery is heavy relative to the other components, so the center of gravity of the unit is near the handle section.

The preferred method of communicating with the reader is through radio frequency data communications (RFDC) such as the 11.0592 MHz crystal board manufactured by RF Monolithics, Inc. An antenna extension **504** is connected to the reader body by means of an antenna connector **505** that is recessed into the reader body. The housing is sealed to minimize damage due to moisture.

In an alternative embodiment to the RFDC communications, the reader can be tethered with a cable and an RS232 interface directly to a computer or external device.

Although a mechanical or other type of switch may be employed, the preferred

method of operating the device is an infrared activation switch, which consists of an infrared light source 511 and an infrared reader 512 which will form a light circuit that can be broken by placing a thumb or a mechanical object in the space 513 between the light source and the reader. The mechanical object is desirable in some circumstances to leave the reader in an  
5 activated state while it is extended further into a working chute.

A holster is typically provided to hold the reader when it is not in use.

Referring to Figure 7 which is a cross sectional view of the reading device described above, the reader consists of a rechargeable battery 565, RFID electronic circuitry 540, an RFID antenna 545, RFDC Data Communications electronic circuitry 560, and a status light  
10 530. The rechargeable battery is preferably a commercially available battery pack such as that used in portable power tools. The RFID electronic circuitry is available from vendors such as Avid Marketing, Inc., Destron/Fearing, Inc., and All-Flex USA, Inc. The RFID antenna is preferably a single wound coil. The antenna, when it is brought within a range that is typically 12-15 centimeters (5 to 6 inches) from the transponder in the case of RFID ear  
15 tags or implants, is able to detect the RFID signal from those devices. The RFID circuitry interprets the signal and communicates the results to the RFDC circuitry, which communicates that result by means of radio frequency broadcast with a typical range of up to 20 meters (800 feet). Greater distances can be accomplished by substituting other commercially available RFDC circuitry. The status light 530 is preferably a 3-stage LED  
20 display that will show one color to indicate that the power is in the ON state, a second color to indicate that an RFID signal has been detected, and a third color to indicate that the RFID signal has been confirmed by the host computer.

Referring to Figure 8, which is the handle end view of the reader, the RFDC antenna 504 extends toward the user, and the status light 530 is located such that the user can

observe the light while operating the reader. The thumb switch is defined by the infrared components 511 and 512 that are typically located at the top of the unit.

## **EXAMPLE- THE BEEFLINK™ DATA COLLECTION AND MANAGEMENT**

### **5 SYSTEM**

BeefLink is a beef cattle data collection and data management implementation of the current invention. The Beeflink system is easily adaptable to other livestock species, with the major change being the definition of industry-specific default events

BeefLink is comprised of hardware and software to permit the user to scan radio  
10 frequency identification (RFID) ear tags, implants, collars, or boli with radio frequency identification scan readers; to enter new animals; to look up information on existing animals; to input new events; and to run queries on the work done. One objective of the software is to display pertinent data on each animal and add new events to the record in the least intrusive manner. The new animal records and events recorded are uploaded and  
15 incorporated into a larger database. Communication with the larger database allows the user to receive downstream animal performance data at his own computer.

The minimum components necessary to operate the system are as follows: a host computer which is an IBM-compatible desktop or laptop computer with Windows™95 (or higher) operating system; 50MHz 486 processor; 8 MB RAM; one serial port; 300 MB hard  
20 drive; 14.4 Kbps modem; 3.5" Floppy disk drive; external power supply; MS-Access™97 database software; BeefLink™ data collection software; Hand-held RFID reader with an RS-232 output capability; a null modem cable (DB9F to DB9M) up to 12.7 meters (50 feet) between laptop and reader; and RFID transponders on each animal.

The preferred components of the system are as follows: a host computer which is an IBM-compatible desktop or laptop computer with Windows™95 (or higher) operating system; 133MHz Pentium processor or higher; 32 MB RAM; one serial port; 1 GB hard drive or higher; 28.8 Kbps modem; 3.5" Floppy disk drive; CD-ROM drive; Sound card and driver; external speakers; external power supply with DC connection; PC-Anywhere™ remote access software; MS-Access™97 database software; BeefLink™ data collection software; Hand-held RFID/RFDC reader with an LED indicator to confirm data receipt by computer; external RFDC transceiver at computer for communication to/from reader; Data Concentrator with external multiple serial ports; RFID transponders on each animal; and an RFID Work Card with action tags.

Referring to Figure 10 which is a schematic of one embodiment of a data collection system, the Beeflink software runs on the host computer 10 which may be either laptop or desktop computer. The computer is in contact, by means of wireless radio frequency 52, with a multiple input/output device or data consolidator 50. The wireless connection is accomplished by means of a transmitter/receiver 71 connected to the host computer, and a transmitter/receiver 72 connected to the data consolidator by means of a serial port. In cases where the data consolidator may be located at relatively large distances from the host computer, it may be necessary to use a larger RFDC antenna 63. In some cases, it may be desirable to connect a keyboard 61 and monitor 62 to the data consolidator.

In the embodiment shown, the reader 30 is connected to a port on the data consolidator through a cable 38 and a serial port 53. In alternate embodiments, the reader is connected to the data consolidator by wireless radio frequency data communication. The reader may read an animal RFID transponder 32 and a Work Card 31, which consists of

multiple event RFID transponders. The host computer 10 is connected to the Internet 77 by means of a modem 12.

Other computers 79 and 80 containing other databases 78 and 81 may be connected to the Internet by means of a modem 76, such that data may be transferred over the Internet between the host computer and the other computers. Other embodiments illustrate the use of the Beeflink software on both simpler and more complex data gathering systems.

Double-clicking the BeefLink icon on the Windows 95 Desktop display starts the BeefLink program. When the Company ID, the User ID, and the Password are entered on the Authorization Screen display, the program can be accessed.

Once authorization has been verified, a Command Center display permits graphical user interface navigation to the Data Collection Center, the Communications Center, the Report Center, or Housekeeping. The Housekeeping functions include Setup User Security, Password setup, and Program Defaults configuration such as units of measure, choice of language, and date formats.

The Data Collection Center permits equipment setup so that the BeefLink system can receive data from multiple devices or output data to multiple devices.

The RFID reader typically communicates either wirelessly or through a cable to the "Comm 1" serial port on the data concentrator unit. In some cases, the reader will be the only equipment used, and no equipment setup will be required. In some simpler applications, a data concentrator unit may not be used, and the reader may be connected directly to a computer port, or communicate in a wireless fashion to a radio receiver/transmitter which is connected directly to a computer port.

If equipment in addition to the RFID reader is used, it will be connected through a serial port on the Data Concentrator unit. The Data Concentrator unit has multiple serial

ports, each of which is default labeled for specific types of equipment which is commonly used in the beef industry. The user simply plugs each device into the proper port on the Data Concentrator unit.

The default devices and communications ports include:

5	CommPort 1	RFID Device
	CommPort 2	Scale for weight measurement
	CommPort 3	Digital Thermometer for temperature measurement
	CommPort 4	Ultrasound for backfat measurement
	CommPort 5	Barcode for treatment identification
10	CommPort 6	Printer for output

The RFID reader is always connected to port 1, and is used to read both animal ID tags and event tags. Its configuration cannot be changed. Port 2 is connected to an electronic weigh scale and is used to collect animal weights. Port 3 is configured for a digital thermometer and is used to collect body temperatures. Port 4 is connected to ultrasound equipment used to measure back fat. Port 5 is connected to a bar code scanner and is used for collecting the identity of drugs used as treatments. Port 6 is connected to a remote printer that prints labels for veterinary samples that are being collected.

The user may connect equipment other than the devices on the standard list by editing, in the Beeflink software, the information for Ports 2 through 6, or by adding information for a new port.

In order to speed data entry, Action Tags are used to enter most events. Rather than typing in events at the computer keyboard, events are assigned to the Action Tags ahead of time so that the tags are simply scanned with the same reader used to scan animals in order to enter events or update fields in an animal's record. For instance, if cows are being

checked for pregnancy, An Action Tag will be assigned beforehand for both the "pregnant" and "open" result so that the user can scan the cow and the appropriate pregnancy Action Tag when the result is known. Another example is that certain animals being processed are vaccinated for shipping fever. An Action Tag is assigned to the shipping fever vaccination event so that when animals get the vaccine, the user can scan the animal and the shipping fever Action Tag in order to record the event.

The Action Tags are typically affixed to a Work Card alongside their corresponding event labels. The Work Card can be placed in strategic locations such as on the side of a working chute or with the vaccine or treatment bottle to which they are assigned.

Most common events will identified with Action Tags when the user receives the system. The user may, however, add to or change existing events through the Event Setup form in the Setup section of the Data Collection screen.

Each event has one or more default details associated with it. For instance, the event "LOCATION" might have three different details such as PEN-1, PEN-2, and NORTH 4000, that can be used to record changes in animals' locations.

To add or change an Action Tag associated with an event, the user first connects the RFID reader to Comm 1 of his Data Concentrator unit. The user then scans the Action Tag, and the unique transponder number of the tag will appear in the first text box of the setup screen. The user can then select or type the new assigned event. The same procedure can be repeated for as many Action Tags as desired to link to new events and details.

A default list of all of the events is shown below. It is desirable to use these default events when appropriate because they update fields in the database. If none of the default events apply, the user may key in a new event.

**Event List:**

1	Abort
2	Assess Animal
3	Assess Animal-Healthy
4	Assess Animal-Sick
5	Assign Value
6	Birth
7	Birth-Est
8	Brand
9	Bred-AI
10	Bred-Bull-Grp
11	Bred-Bull-Ind
12	Breed
13	Buller
14	BullOut
15	Calving
16	Carcass
17	Carcass Weight
18	Clock-In
19	Clock-Out
20	Clone
21	Color
22	DamID
23	Diagnose
24	Died
25	Dry Conversion Rate
26	Feed
27	Feedlot In
28	Feedlot Out
29	Feed-Ration-Start
30	Finance
31	Group
32	HACCP
33	Hedge
34	Hedge-Remove
35	Implant
36	Implant-Remove
37	Incident
38	Incident-Removed
39	Insure
40	Irradiate
41	Location
42	Metal Tag
43	Origin
44	Packer-In
45	Packer-Out
46	PregChk
47	Production_Destination
48	Purchase

49	Railer
50	RegNum
51	Retag
52	Retailer_Feedback
53	Roundup
54	Sell
55	Set Alliance
56	Sex
57	SireID
58	Slaughter_Date
59	Spay
60	Stocker-In
61	Stocker-Out
62	Synchronize
63	Tag Brand
64	Trailer
65	Transfer
66	Treat
67	Vaccinate
68	Visual Color
69	Visual ID
70	Wean
71	Weather
72	Weigh
73	Weigh-Average
74	Wt-Birth
75	Wt-Birth-Est
76	Wt-Est
77	Wt-Feedin
78	Wt-Feedout
79	Wt-Packerin
80	Wt-Packerout
81	Wt-Purchase
82	Wt-Sell
83	Wt-StockerIn
84	Wt-StockerOut
85	Wt-Wean

The most efficient way to record repetitive events that occur to multiple animals is to assign animals to logical groups and to record the events to all animals in the group.

For example, if all animals in group 1 (GRP-1) are moved from Pen 50 to Pen 65  
5 without processing the animals through a chute, the user may click on the "Assign Group  
Events" button at the Data Collection Center to open the Group Event entry and then click

on the Group drop-down menu and select "GRP-1". The user would then click on the Event drop-down menu and select "Location" and then click on the Detail drop-down or key in "Pen-65". The user would then click the "Add" button at the bottom of the form and the event will display in the grid in the middle of the form. The user may click the "Update  
5 Record" button to add the event to all animals in GRP-1.

The form also allows for entering multiple events and details before updating the group. For instance, if every animal in a group had a change in their ration and received a group treatment in their feed, the user could select and "Add" both events, and then update the records.

10 When all animals being processed receive the same treatments, but don't belong to a particular group, the default event option should be used. This feature permits the user to pre-select events for all animals. Then, as the animals are scanned, each animal's record is updated with the default events and details, until the function is turned off.

For example, a stockman operation is receiving 50 new calves from a ranch, and the  
15 stockman needs to record the origin of each animal, the vaccines given each animal, the identity of the group, and the location where the animals will be going. As each event and detail is selected, it is added to the Default Event Form by clicking on the "Add" button. With the default feature turned on, each animal scanned will have its Origin recorded as "SMITH RANCH", receive a vaccine event called "SHIPPING FEVER", be placed in a  
20 group called "NEW", and have the location "NORTH PASTURE" saved to its record.

Any time that different events need to be recorded on each animal, the events must be applied individually. For example, if cows are being checked for pregnancy, the results vary and need to be recorded individually. Another example is when sick animals are treated at a feedlot – different treatments are applied and recorded individually. Recording individual

events is automated by using the Work Card described earlier. After an animal is scanned, the events on the card that apply are scanned and thus recorded. This method can be used in conjunction with default events – all animals receive the default events and some also receive additional individual events.

- 5           If animals are receiving new sequential visual and/or metal ear tags, they can be sequenced automatically so that the tags increment as each animal is scanned. To set the starting sequence for new tags, the user can click on the “Sequence New Ear Tags” button at the Command Center and enter a tag prefix or Starting Tag Number.

          Once the starting ear tag sequences have been set, they are ready to use when the  
10   user needs them. The user may activate sequencing as a default event or with an Action Tag.

          Before working cattle, the user may either verify or make changes to his Work Card through the “Verify Work Card” button in the Prepare to Work section of the Data Collection form. In order to verify that an Action Tag is actually associated with the correct event, the user will scan the Action Tag. If the tag has been assigned as an event, the user  
15   will get a duplicate error-trapping message. By the “OK” button on the error message, or pressing the Enter key, the screen will display the event currently associated with the Action Tag.

          If the event associated with the Action Tag is correct, then the user can continue scanning other Action Tags that need to be verified. If the user needs to change the event  
20   associated with the tag, the user erases the current entry and enters a new event and detail for the deleted Action Tag.

          When the user is ready to work animals, which will usually be done at the working chute, the user can click the “Start” of the screen. Before the user can begin, he must intentionally turn the default events either on or off by clicking the appropriate radio button.

The program won't let the user do anything until one of the buttons is clicked. This way, the user won't set up defaults and forget to turn them on, or assign default events by mistake.

With the RFID reader cabled or wireless radio cabled to Comm 1, the user is ready to start scanning animals.

5           For example, if the first animal scanned has existing records in the system, the display screen will show those data fields. The scroll bar may be used to view additional fields. The bottom half of the screen shows all events recorded during the animal's lifetime. If the user scans a "TREAT" Action Tag with "IVOMECH" for the detail and changes the animal's location to Pen 50, the records will be updated.

10           Although the user may watch the results of his scans on the screen, it's not necessary to see the screen while processing animals. A feedback acknowledgement in the form of a light or sound may be sent to the user to indicate that the scans have gone through correctly. This feedback can be in the form of a light or sound generation by the Data Concentrator unit, or it may be directed through a serial port to an external device. Typically the user will  
15           get a positive feedback signal in the form of a burst of light and an audio acknowledgement when he reads an animal that exists. The user will also get the acknowledgement when he scans an event.

          When a new animal is scanned, the system cannot recognize the RFID transponder scanned so the user is signaled to re-scan the animal to verify that it was read. Upon  
20           receiving the verified scan, the system enters the new animal into the database. The new animal has only one piece of data so far – its RFID transponder number. Other data is entered in the normal method, either individually or as defaults.

          If all of the animals being worked are new to the system, some defaults will probably be entered into the system. For instance, if all animals have the same estimated birth date,

the date can be set as a default and added automatically to the birth date field of each new animal scanned. The same default function could be used for origin, location, or group.

If, however, the animals have varying birth dates or birth years, the available birth dates can be assigned to Action Tags, using the event setup form. The user can use

- 5 BIRTHDATE as the event and the date as the detail. As each animal is scanned, the correct birth date tag is scanned and assigned to the animal.

- If actual birth dates are used and there are many possible entries, the user will enter the dates individually. The user will set up an Action Tag event with BIRTHDATE as the event and KEY as the detail. To add a specific birth date to the animal's record, the user will
- 10 scan the animal and the Action Tag. The user is then prompted to key in the birth date.

Entering non-sequential visible or metal tags may be done in the same manner.

- If an animal loses its RFID tag the animal can be re-tagged, and an Action Tag with "RETAG" as the event can be used to replace the old tag references. The system can be used with visual ID tags and barcode tags, but RFID transponder ear tags are the preferred
- 15 identification method.

Animal body weights can be entered in several ways. First of all, there are many different types of weights that can be recorded. Periodic weights are the most common, but other specific weights such as weaning weight, stocker-in weight, feedlot-in weight, etc. can be specifically noted.

- 20 Weights can either be recorded automatically with an electronic scale, or keyed in using a keyboard or other peripheral method. If the weights are to be gathered automatically, the user should identify the port through which the weights will be entering. The user will select the appropriate weight event and select the detail, either AUTO for a scale connected to the system, or KEY if weights will be keyed in. If the event is a default to

be collected on all animals on a connected scale, the weights will be collected automatically. If the default is the keyed weight, each time an animal is scanned, the user will enter a weight. If the user is not weighing all animals, the same events can be scanned as Action Tags.

5           In addition to setting default events at the computer, defaults can be assigned, turned on and turned off in the field such as at the working chute. For example, if the user has fifty animals being worked that receive the same events – the events can be identified and turned on while working the cattle. If the next group of animals being worked receive different defaults, then the current defaults can be appended or cleared and new ones assigned.

10           An Action Tag labeled “ADD DEFAULT EVENTS” is scanned prior to identifying which events will be defaults. Next, the event or events that the user desires to be defaults are each scanned. The user then scans all animals to which the defaults apply. If the defaults need to be cleared, the user scans the “RESET” tag to clear the field-assigned defaults. This will not change the defaults that have been turned on at the computer – they are turned on  
15           and off only at the computer in the “Set Default Events” screen.

          If the user mistakenly assigns events to an animal and wishes to delete them, he can “scan the “Delete Events” tag. This will remove all events that have been assigned to the animal for the current date. Any events that are correct should be rescanned. This function also works well if the user is assigning default events to a majority of the animals, but wants  
20           to skip certain animals. The user can simply scan the Delete Event tag after the animal that does not receive the events is scanned.

          To do a detailed review of an individual animal, the user can click the “Animal” button in the Review section of the Data Collection form. The animal record contains some basic header information, as well as an on-going list of events, weights, and animal

movements. To review an individual animal, the user scans the transponder or types in the visual or metal ear tag number. The events listed on the animals record can be sorted in order of the events, the details, or by date. The user can also do a quick review of all recorded weights or locations by clicking the applicable radio button on the bottom of the form.

5       The information collected on all animals can be reviewed by clicking on the "Work Done" button in the Review section of the Data Collection Center. This form allows the user to query the data that has been collected by selecting the field and the criteria of the search.

Clicking the "Reports" button in the Command Center screen can access a multitude of local management reports. Reports that cover information on animals that have left the  
10   ranch or feedlot will be available from the regional or national database VIA the Internet.

Events recorded on each animal will typically be exported to a larger database. The larger database will not only store information on other animals, but will store information on one entity's animals that have been transferred to other entities. The user may click on the "Export" button at the Command Center to create the file for uploading to the larger  
15   database. The export file is in the form of an event file, with special entries for new animals added to the local database.

Many events can be identified by a single code and a single set of associated data. Other events such as an animal vaccination event require additional data. The user can read an event detail transponder, such as vaccine type, and can then read sub-detail events such as  
20   a dosage or batch that he wants appended to the main detail. This is accomplished by identifying each event detail as either a STANDARD or SUB detail. If the detail is a sub event, then it will append to the last standard detail scanned. For instance, along with a vaccine,

For instance, the user may want to add a dosage, a batch code, or a cost associated

with the vaccine. The user can scan an event detail and then scan any sub details, such as dose and batch, to append to the main detail. Each standard detail is identified as to whether it can have sub details appended to it.

## 5 EXAMPLE- A PAPER-BASED EMBODIMENT

Figure 1 illustrates a paper-based embodiment of the BeefLink data collection software. In this case, animal identification would be obtained from a visual tag, such as an ear tag, and that visual identification would be written on a paper log 14. All event data and measurement data would be recorded on the log sheet and then entered by keyboard into the BeefLink software running on the host computer 10. The modem 12 in this embodiment permits the host computer to establish data transfer capability with other computer, and the removable disk 13 provides a data backup capability.

Although the data entry would be cumbersome for large numbers of animals, this paper system may be more affordable for smaller producers.

15 The producer may elect to install only visual identification or to install a tag that is both visual and RFID.

If an RFID transponder were attached to an animal, the producer would be responsible for manually entering the code to the computer, so that the code would be correlated to the visual tag identification.

20 Alternately, it is possible to operate the BeefLink software on the basis of the visual identification, or preferably a longer, unique identification key assigned to the animal. In that event, an RFID device may be attached downstream, and the new RFID code would be assigned to the animal.

**EXAMPLE- A DIRECT READER EMBODIMENT**

Figure 3 illustrates a simple embodiment of the BeefLink data collection software with an RFID reader 30, which was linked by cable 33 to a host computer 10. In this case, animal identification would be obtained from an RFID transponder 32, and Work Cards 31  
5 where RFID event transponders are used to record events.

The speaker 11 provides a feedback means to confirm the receipt of animal and event data by the computer.

The modem 12 in this embodiment permits the host computer to establish data transfer capability with other computers, and the removable disk 13 provides a data backup  
10 capability.

This approach would typically be used by relatively small producers who could complete their livestock work sessions in a relatively short time, such as the battery life of a notebook computer. In this embodiment, measurement data might be ported directly to the computer 10 rather than a data consolidator.

**EXAMPLE- SIMPLE WIRELESS READER EMBODIMENT**

Figure 4 illustrates a simple embodiment of the BeefLink data collection software with a radio frequency wireless connection 40 between the RFID reader 30 and the host computer 10. In this case, animal identification would be obtained from an RFID  
20 transponder 32, and Work Cards 31 with RFID event transponders are used to record events.

The speaker 11 provides a feedback means to confirm the receipt of animal and event data by the computer.

The modem 12 in this embodiment permits the host computer to establish data

transfer capability with other computers, and the removable disk 13 provides a data backup capability.

### EXAMPLE-EXISTING SYSTEM COMMUNICATION

5           Figure 2 illustrates the ability of the BeefLink software running on a host computer 10 to accept data from an existing livestock management system 20 or to update the management system data with information from BeefLink. If the existing management system software was not running on the host computer, the host computer could establish a link to the existing management system computer by means of a modem 12 and either a  
10   direct link or an Internet connection. A data protocol converter 21, which may be resident on either computer, would coordinate the transfer of data to and from the BeefLink program to the management system software.

          Figure 9 illustrates this existing system or existing database communication in a wireless reader embodiment. The RFID reader 30 communicates through RFDC  
15   transmitter/receivers 36 and 71.

          Existing or downstream database 78 or existing management system software running on a computer 79 may be accessed through the host computer modem 12 by either Internet transfer 77 or by direct modem connection between the computers.

### 20   EXAMPLE-MULTIPLE READER LOCATIONS

          Figure 11 illustrates a wireless reader configuration where the data concentrator 50 receives data from multiple RFID readers indicated by readers 30 and 45. This type of configuration is desirable in larger operations where there may be more than one livestock working area at a given time. In this case, a larger antenna 63 may be necessary at the data

concentrator, and it may be desirable to have a keyboard 61 and monitor 62 connected to the data concentrator.

### **EXAMPLE- DESCRIPTION OF THE PREFERRED EMBODIMENT**

5           The preferred embodiment is a data collection and management system for beef cattle production as indicated by Figure 12. The components of the data collection and management system in the preferred embodiment include unique Radio Frequency Identification (RFID) transponders for each animal; an Action Card of RFID transponders to identify livestock events, an RFID Reader that can identify the animal and event RFID  
10   transponders; a wireless RFDC communication between the reader and a data consolidator unit which has multiple ports for livestock measurement data; a multi-ported data concentrator unit for connection to a scale, a thermometer, an ultrasound measurement device, and an output device, a wireless RFDC communication between the data concentrator unit and the host computer; BeefLink™ Data Collection Software; and  
15   database protocol converter communication and integration tools.

#### **Radio Frequency Identification (RFID) transponders**

          Although the data collection system can operate manually with visual animal identification, the preferred operation is with Radio Frequency Identification (RFID)  
20   transponders 32 in the form of electronic ear tags, implants, boli or neck or leg collars to provide unique identification for each animal. Although ear tags and implants are the most common devices, a bolus transponder has been used successfully as a tamper-proof means of identification of cattle. The bolus transponder has the potential capability of measuring temperature and pH within the animal. The RFID transponders contain a small antenna

attached to an integrated circuit that stores a unique identification number. Unlike bar codes, RFID transponders do not require line-of-sight to be read, the transponder simply needs to come into the proximity of an RFID reader.

## 5 RFID Reader

The RFID reader 30 will typically be a stationary reader at high volume at the packer or feedlot operations and portable readers at other processing points. Stationary readers will be typically be connected to a host computer or data consolidator by means of a cable, but a wireless connection may also be used for stationary readers. The portable readers will typically use a wireless connection to the computer. The readers emit a low radio frequency, typically a 134.2 kHz signal that excites the passive transponder in the event or animal identification tag. Once excited, the transponder responds back to the reader via radio frequency with a digital signal representing its unique identification code. The reader decodes the signal, displays the identification, and sends the identification to the computer.

15

## Work Card and Event Action Tags

A Work Card 31 with RFID transponders 41, 42 and 43 provides livestock event identification so that events can be read by the RFID reader rather than entered by keyboard. The user may select one or more event cards for the anticipated work session. Other event tags may be more permanently affixed at other convenient locations in the work area, such as around the processing chute. The tags on the work card have a name or symbol label for the corresponding event so that the person working the cattle can quickly scan the appropriate event when it occurs.

20

Data Concentrator

A hardware device called a Data Concentrator 50 is used as a hub to receive inputs from multiple peripherals and to send the data to the processing computer 10. Although the connection between the data concentrator and the computer may be cabled in some high volume applications, the preferred embodiment is radio frequency wireless data communication. One communication port on the data concentrator will typically be dedicated to the RFDC transmitter/receiver, and the host computer will be ported to a transmitter/receiver. Serial data can be both transmitted and received between the computer and the concentrator using standard direct-connect serial cables or via radio frequency data communication (RFDC). The Data Concentrator accepts a signal from the reader through RFDC transmitter/receivers 36 and 71, typically from a serial port 53, and may also accept data from other measurement devices or provide data to output devices through other available ports 54, 55, 56, and 57. These devices can include electronic weigh scales for weighing animals, digital thermometers to determine if an animal has a fever, bar code scanners to scan drug containers, and ultrasound equipment to measure back fat and detect pregnancy. Other peripherals include output devices that notify the user of the results of an input such as a light, an audible signal to signify that the input has reached the computer, an LED display, or an electronic voice response. The preferred model of the data concentrator is Western Telemetric Model STC61, which is a 6 serial port unit.

The Data Concentrator is linked to a host computer 10 through transmitter/receivers 36 and 71, by wireless radio frequency connection between radio frequency transmitter/receivers 71 and 72. The computer receives, processes, and stores the RFID scans and other data and generates a feedback confirmation signal back to the Data Concentrator. The preferred computer is an IBM™-compatible desktop or laptop computer

with a Windows™ 95 operating system.

### BeefLink™ Data Collection Software

The BeefLink™ software running on the computer 10 validates inputs from the various devices, notifies the user of the data received, stores the results, and converts the data into meaningful information. In addition, the software manages the transfer of the local data via modem to regional and national databases for storage and further analysis, and manages the access to downstream processing, performance, and quality data.

### 10 Database Architecture and Data Transfer

Data collected at the local level can provide only limited management information to the producer because the producer needs to know the performance results in order to manage accurately for the future. As the data is transferred to a regional or national database, indicated in as 78, it can become more powerful. In many cases, the animals change hands during the production cycle. In order to get results back to the producers and growers of the livestock, these upstream participants must have the ability to pull information about the animals that the downstream participants enter into the system. Likewise, the downstream participants such as feedlots and packers need to review information on the animals that they are receiving. It is also these large databases that allow for the source verification for food safety issues.

The local software at each participant's facility routinely sends file updates to an alliance or national database using modem transfer through the Internet. With the proper security clearance, users can query the data on their own cattle even after they have been transferred or sold, and this is the information useful for future management decisions.

Producers are also able to purchase reports that benchmark their animals against a compilation of blind data from other producers. For example, producers may compare their operations with operations of a similar size, geographic region, or breed for quality characteristics such as the tenderness score.

5           Once the animal reaches the slaughter plant, the same RFID transponder is used for identification. Stationary readers are used to read the transponders and to identify and sequence the carcasses. Data such as carcass weight, grade, and yield are collected and added to packer's management system, and that data can be accessed through the animal's identification.

#### 10           Authorization Levels

In the preferred embodiment, authorization levels are provided for various entities such as a consultant, veterinarian, nutritionist, or banker, can access information according to that entity's authorization level.

#### 15           Source Verification/Performance Tracking

In the preferred embodiment, the RFID tags, and visual identification tags are correlated so that at any point in the livestock cycle, historical data is available to any entity in the chain of title for the livestock.

20           At the packing plant, the animal's identification is used to record actual carcass quality data for the animal. The data can include overall evaluation of the carcass as well as information about the amount and quality of particular cuts or products derived from the carcass. This correlation of individual animal identification to actual carcass and product quality data permits the packer to compensate the producer or feedlot according to the actual

quality of the product. The producer benefits both by having the potential to receive a greater return for higher quality livestock, and by obtaining information which will permit more informed decisions on herd management. For instance, bulls or cows that produce calves with good yields and quality will be preferred for retention in the herd over bulls or  
5 cows that produce calves with lower yields or lower quality.

Whereas the prior art requires transmission of packer information back to the feedlot or to producers, the present invention permits entities in the chain of ownership to have access to the data associated with an animal. An additional objective of the invention is to provide Source Verification by making historical data for the animal available to the packer.

10 This Source Verification will preferably include certified quality control programs such as HACCP plans.

5

10

**CLAIMS**

What is claimed is:

1. A method for collecting livestock information comprising:

- 15 identifying each animal with a unique radio frequency identification transponder, such that the transponder provides a unique code when queried by a radio frequency identification reader unit, and that code identifies a particular animal;
- reading the animal unique code with radio frequency identification reader at the time of a key animal event;
- 20 uploading the animal unique code from the reader to a remote host computer by means of wireless radio frequency data communication;
- entering data associated with the key animal event to the computer; and
- maintaining on at least one computer a database of events and measurement data for

the animal, such that the data can be accessed according to the animal's unique code.

2. The method of Claim 1 comprising the additional steps:

identifying one or more animal event with a unique radio frequency identification  
5 transponder, such that the transponder provides a unique code when queried by a  
radio frequency identification reader unit, and that code is cross referenced to an  
event so that it identifies a type of event;

reading the animal event unique code with radio frequency identification reader at the  
time of a key animal event; and

10 uploading the animal event code from the reader to a remote host computer by means  
of a wireless radio frequency connection.

3. The method of Claim 2 wherein

one or more animal event unique radio frequency identification transponder is affixed  
15 to a rigid surface and the reading of an animal event unique alphanumeric code is  
accomplished by placing the reader in the proximity of the event transponder.

4. A method for collecting livestock information comprising:

identifying each animal with a unique radio frequency identification transponder, such  
20 that the transponder provides a unique code when queried by a radio frequency  
identification reader unit, and that code identifies a particular animal;

reading the animal unique code with radio frequency identification reader at the time  
of a key animal event;

uploading the animal unique code from the reader to a remote host computer by

means of a wireless radio frequency connection;  
entering data associated with the key animal event to the computer;  
maintaining, on more than one computer, a database of events and measurement data  
for the animal, such that the data can be accessed according to the animal's unique  
5 code; and  
communicating between the databases such that desired information is shared  
between the databases without the necessity of reentering data.

5. The method of Claim 4 comprising the additional steps:

10 identifying one or more animal event with a unique radio frequency identification  
transponder, such that the transponder provides a unique code when queried by a  
radio frequency identification reader unit, and that code identifies a type of event;  
reading the animal event unique code with radio frequency identification reader at the  
time of a key animal event; and  
15 uploading the animal event unique code from the reader to a remote host computer  
by means of a wireless radio frequency connection.

6. The method of Claim 5 wherein

one or more animal event unique radio frequency identification transponder is affixed  
20 to a rigid surface and the reading of an animal event unique code is accomplished by  
placing the reader in the proximity of the event transponder.

7. The method of Claim 6 comprising the additional step:

setting, before the event, at least one default data value for a key animal event, such

that the default data value reflects the expected value of particular event data.

8. The method of Claim 7 wherein

the setting of the default data values is accomplished on a host computer.

5

9. The method of Claim 7 wherein

the setting of the default data values is accomplished at a livestock working location.

10. The method of Claim 7 wherein

10 the setting of the default data values is performed simultaneously for a group of animals.

11. The method of Claim 5 wherein

15 the animal identification data and animal event data value is captured with a multiple input/output device, such that the multiple input/output device can accept the animal unique code from radio frequency identification reader, the multiple input/output device can accept the unique code for at least one particular animal event code from the radio frequency identification reader, and the multiple input/output device can accept data from at least one livestock measuring device.

20

12. The method of Claim 11 wherein

the livestock measuring device is an electronic scale.

13. The method of Claim 11 wherein

the livestock measuring device is a digital thermometer.

14. The method of Claim 11 wherein

the livestock measuring device is an ultrasound device.

5

15. The method of Claim 11 wherein

the multiple input/output device provides a communication port to at least one output device.

10 16. The method of Claim 4 wherein

the radio frequency identification reader is capable of reading radio frequency identification transponders of more than one type.

17. The method of Claim 4 comprising the additional steps:

15 maintaining portions of the data related to a particular animal on a first data base;  
maintaining portions of the data related to a particular animal on a second data base;  
and  
communicating between the first data base and the second data base by means of a  
data protocol converter such that the converter allows data from the first database to  
20 be accessed and used in the second database, and the converter allows data from the  
second database to be accessed and used in the first database.

18. The method of Claim 4 comprising the additional step:

providing a feedback confirmation signal from the host computer to a feedback

means located in the proximity of the reader, such that the feedback means confirms the receipt of data at the host computer.

19. The method of Claim 18 comprising the additional step:

5        comparing the data, at the host computer, to preset data range limits and providing the feedback confirmation signal if the data is within the range limits.

20. The method of Claim 18 wherein

the feedback means is located on the reader.

10

21. The method of Claim 18 wherein

the feedback means is attached to a multiple input/output device.

22. The method of Claim 18 wherein

15        the feedback means is at least one light.

23. The method of Claim 18 wherein

the feedback means is an audible signal.

20    24. The method of Claim 23 wherein

the audible signal is provided to wireless headphones.

25. The method of Claim 18 wherein

the feedback means is at least one light emitting diode.

26. The method of Claim 18 wherein  
the feedback means is a printer.

5 27. The method of Claim 4 wherein  
the radio frequency identification transponder is integral to an ear tag.

28. The method of Claim 4 wherein  
the radio frequency identification transponder is implanted in the animal.

10

29. The method of Claim 4 wherein  
the radio frequency identification transponder is integral to a ruminal bolus.

30. The method of Claim 4 wherein

15

the radio frequency identification transponder is integral to a collar means.

31. A method for collecting and managing livestock information comprising:

identifying each animal with a unique radio frequency identification transponder, such

that the transponder provides a unique code when queried by a radio frequency

20

identification reader unit, and that code identifies a particular animal;

identifying one or more livestock event with a unique radio frequency identification

transponder, such that the transponder provides a unique code when queried by a

radio frequency identification reader unit, and that code identifies the particular

event;

reading the animal unique code with a radio frequency identification reader at the time of a key animal event;

reading the event unique code with a radio frequency identification reader at the time of a key animal event;

5 obtaining livestock measurement data associated with the event through a multiple input/output device such that the device accepts a signal from the radio frequency identification reader through one port, and the device accepts livestock measurement data through at least one other port;

10 uploading the animal unique alphanumeric code, the event unique code, and the livestock measurement data associated with the event from the multiple input/output device to a remote host computer by means of a wireless radio frequency connection;

15 providing a feedback means such that the host computer verifies receipt of data by sending a signal by means of a wireless radio frequency connection to the multiple input/output device, and the feedback means is ported to the multiple input/output device; and

maintaining, on the host computer a database of livestock events and measurement data for the animal, such that the data can be accessed according to the animal's unique code.

20 32. The method of Claim 31 wherein

one or more animal event unique radio frequency identification transponder is affixed to a rigid surface and the reading of an animal event unique code is accomplished by placing the reader in the proximity of the event transponder.

33. The method of Claim 31 comprising the additional step:

setting, before the event, at least one default data value for a key animal event, such that the default data value reflects the expected value of particular event data so the default value may either be accepted or superceded at the time of the event.

5

34. The method of Claim 31 wherein

the reader is portable; and

the reader communicates with the multiple input/output device by a radio frequency data communications means.

10

35. The method of Claim 31 wherein

the reader is portable; and

the reader communicates with the multiple input/output device by a cable means.

15 36. The method of Claim 31 comprising the additional steps:

maintaining portions of the data related to a particular animal on a first data base;

maintaining portions of the data related to a particular animal on a second data base;

and

communicating between the first data base and the second data base by means of a

20

data protocol converter such that the converter allows data from the first database to

be accessed and used in the second database, and the converter allows data from the

second database to be accessed and used in the first database.

37. The method of Claim 31 comprising the additional steps:

assigning authorization levels to the animal identification and animal event data; and restricting access to the animal identification and animal event data according to the authorization level.

5 38. The method of Claim 31 comprising the additional steps:

identifying an animal with an visual identification code;  
entering the visual identification code to the host computer such that animal event data may be accessed by the visual identification code.

10 39. A method for collecting and managing livestock information comprising:

identifying each animal with a unique radio frequency identification transponder, such that the transponder provides a unique code when queried by a radio frequency identification reader unit, and that code identifies a particular animal;

15 identifying one or more livestock event with a unique radio frequency identification transponder, such that the transponder provides a unique code when queried by a radio frequency identification reader unit, and that code identifies the particular event;

reading the animal unique code with a radio frequency identification reader at the time of a key animal event;

20 setting, before the event, at least one default data value for a key animal event, such that the default data value reflects the expected value of particular event data so the default value may either be accepted or superceded at the time of the event.

reading the event unique code with a radio frequency identification reader at the time of a key animal event;

obtaining livestock measurement data associated with the event through a multiple input/output device such that the device accepts a signal from the radio frequency identification reader through one port, and the device accepts livestock measurement data through at least one other port;

5 uploading the animal unique alphanumeric code, the event unique code, and the livestock measurement data associated with the event from the multiple input/output device to a host computer;

providing a feedback means such that the host computer verifies receipt of data by sending a signal to the multiple input/output device, and the feedback means is ported

10 to the multiple input/output device; and

maintaining, on the host computer a database of livestock events and measurement data for the animal, such that the data can be accessed according to the animal's unique code.

15 40. A portable, hand-held, radio frequency identification reader for collecting livestock information comprising:

a housing enclosing a radio frequency identification antenna, radio frequency identification circuitry, radio frequency data communications circuitry, and a power supply, such that

20 the power supply is connected to the radio frequency identification circuitry and to the radio frequency data communications circuitry,

the antenna is connected to the radio frequency identification circuitry, such that the antenna may capture a radio frequency signal from a radio frequency identification transponder and communicate the signal to the radio frequency

identification circuitry,

the radio frequency identification circuitry may interpret the signal and identify the transponder and communicate the identification to the radio frequency data communications circuitry,

5 a radio frequency data communications antenna integral to the housing, such that the transponder identification may broadcast through the antenna; and  
a switch integral to the housing such that the switch activates the radio frequency identification circuitry.

10 41. The reader described in Claim 40 wherein

a handle is integral to the housing; and

the switch is a sealed thumb switch comprising an infrared receiver and an infrared transmitter located such that the thumb of a hand holding the reader may be easily placed between the receiver and the transmitter to break a circuit of infrared light and  
15 cause the switch to be in an ON position, and the thumb can easily be removed from between the receiver and the transmitter to close a circuit of infrared light and cause the switch to be in an OFF position.

42. The reader described in Claim 40 wherein

20 a status light is integral to the housing, such that the light is connected to the radio frequency data identification circuitry and the light will display a first color to indicate that power is available and the light will display a second color to indicate that a radio frequency identification signal has been received and interpreted.

43. The reader described in Claim 40 wherein

an audio feedback means is connected to the radio frequency data communications circuitry, such that a confirmation signal may be received by the radio frequency data communications circuitry and broadcast through the audio feedback means.

5

44. The reader described in Claim 40 wherein

the radio frequency data communication circuitry may be removed as a module and replaced with a direct cable connection from the reader to an external device.

10 45. A portable, hand-held, radio frequency identification reader for collecting livestock information comprising:

a housing enclosing a single wound radio frequency identification antenna coil, radio frequency identification circuitry, radio frequency data communications circuitry, and power supply, such that

15 the power supply is connected to the radio frequency identification circuitry and to the radio frequency data communications circuitry,

the antenna is connected to the radio frequency identification circuitry, such that

the antenna may capture a radio frequency signal from a radio frequency

identification transponder and communicate the signal to the radio frequency

20 identification circuitry,

the radio frequency identification circuitry may interpret the signal and identify

the transponder and communicate the identification to the radio frequency data communications circuitry;

a radio frequency data communications antenna integral to the housing, such that the

transponder identification may broadcast through the antenna;  
a handle integral to the housing;  
a switch integral to the housing such that the switch activates the radio frequency  
identification circuitry and the radio frequency data communications circuitry and the  
5 switch is a sealed thumb switch comprising an infrared receiver and an infrared  
transmitter located such that the thumb of a hand holding the reader may be easily  
placed between the receiver and the transmitter to break a circuit of infrared light and  
cause the switch to be in an ON position, and the thumb can easily be removed from  
between the receiver and the transmitter to close a circuit of infrared light and cause  
10 the switch to be in an OFF position; and  
a data receipt feedback means integral to the housing.

46. The reader described in Claim 45 wherein

the feedback means is a status light means connected to the radio frequency data  
15 communications circuitry, such that the will display a first color to indicate that  
power is available, a second color to indicate that a radio frequency identification  
signal has been received, and a third color to indicate that an external device has  
confirmed receipt of the data.

20 47. The reader described in Claim 45 wherein

the feedback means is an audio feedback means connected to the radio frequency  
data communications circuitry, such that a confirmation signal may be received by the  
radio frequency data communications circuitry and broadcast through the audio  
feedback means.

48. The reader described in Claim 45 wherein

the reader is a multiple device reader such that it may read transponder devices of more than one type.

5

1/10

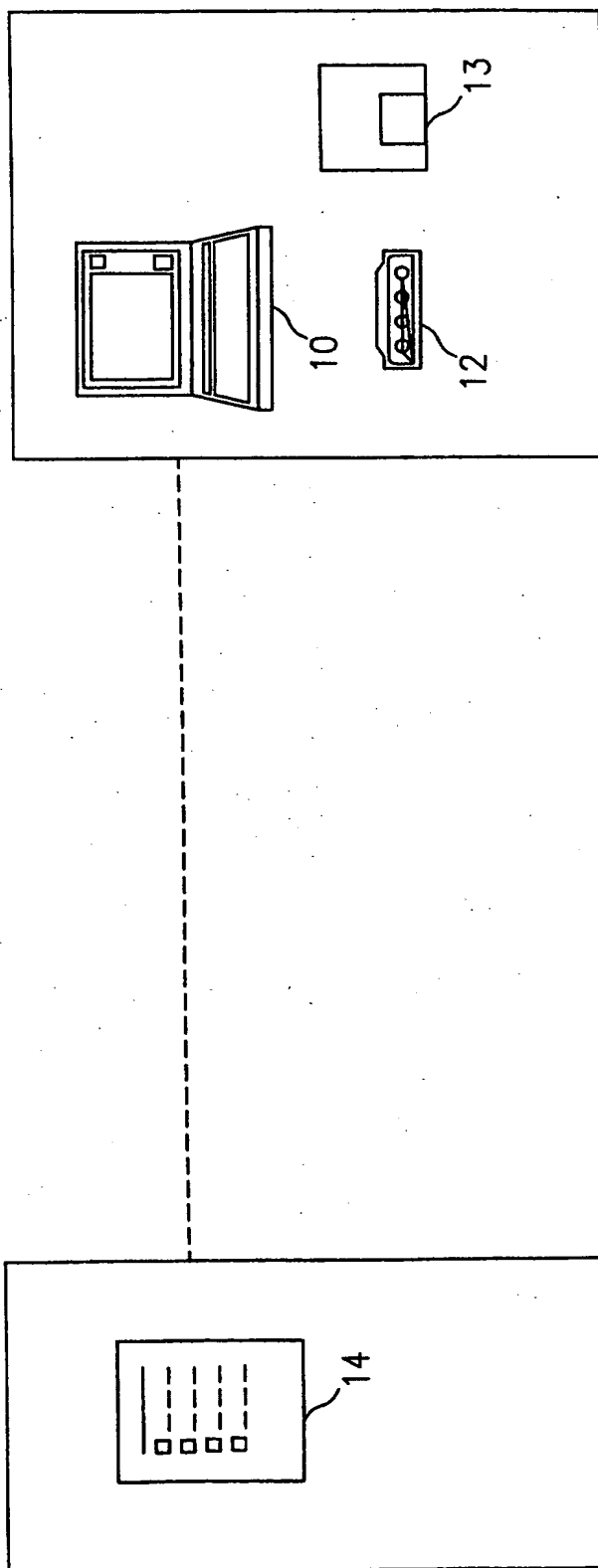


FIG. 1

2/10

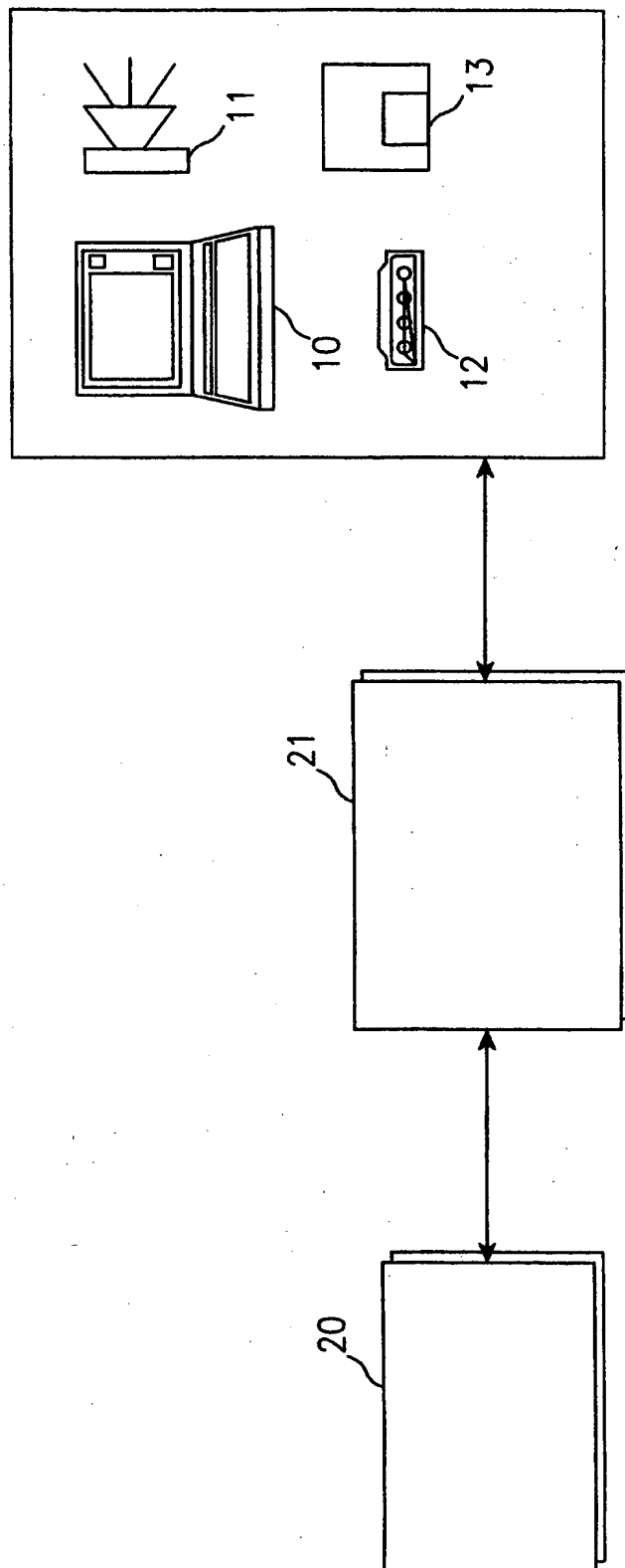


FIG. 2

3/10

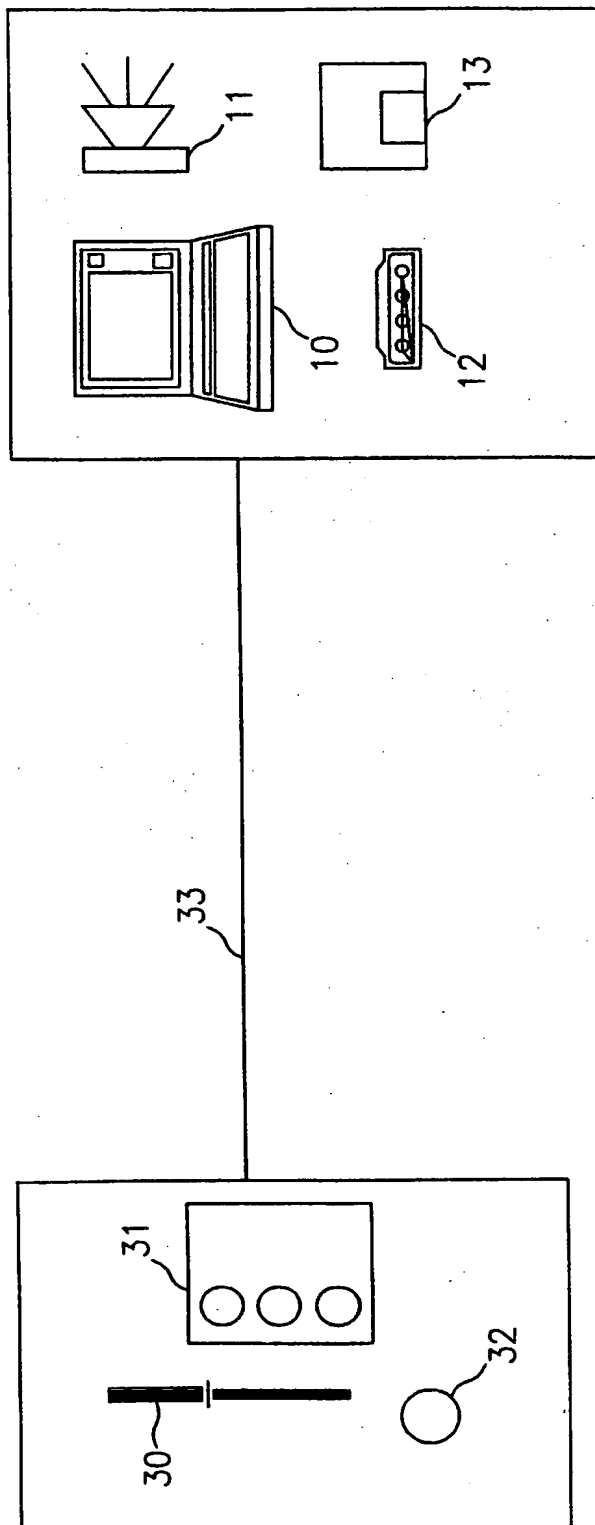


FIG. 3

4/10

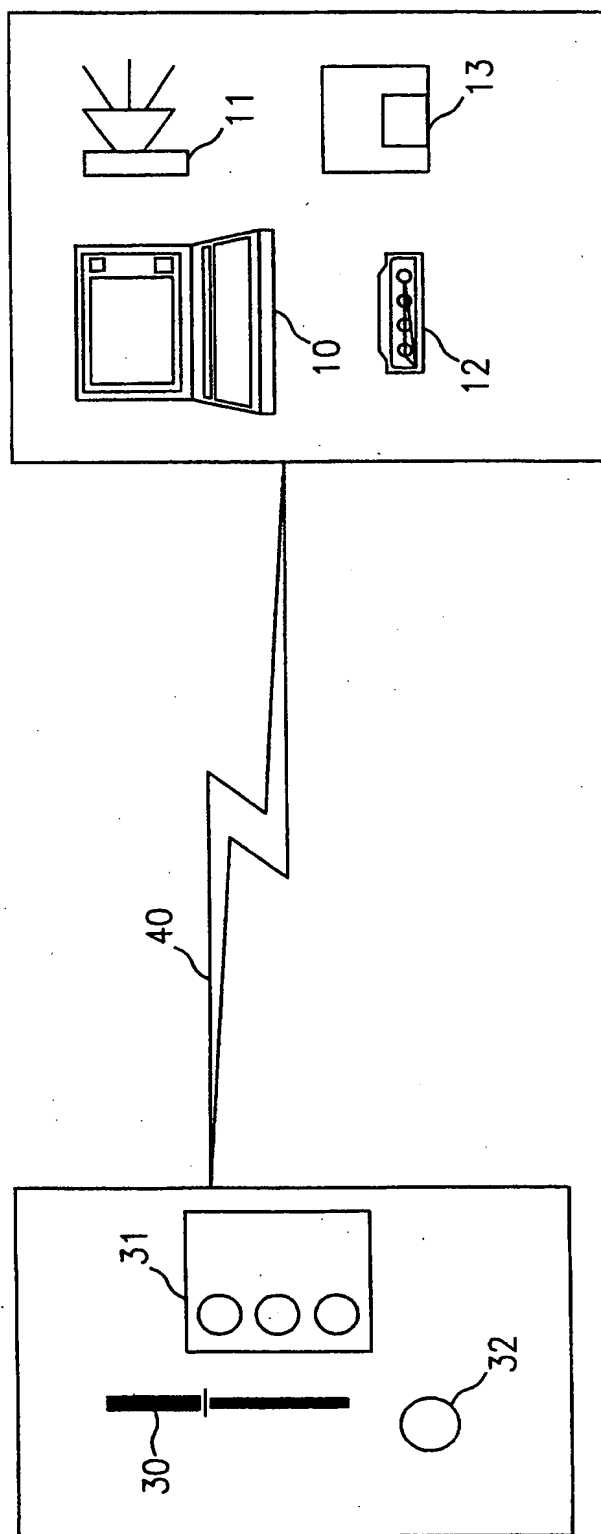


FIG. 4

5/10

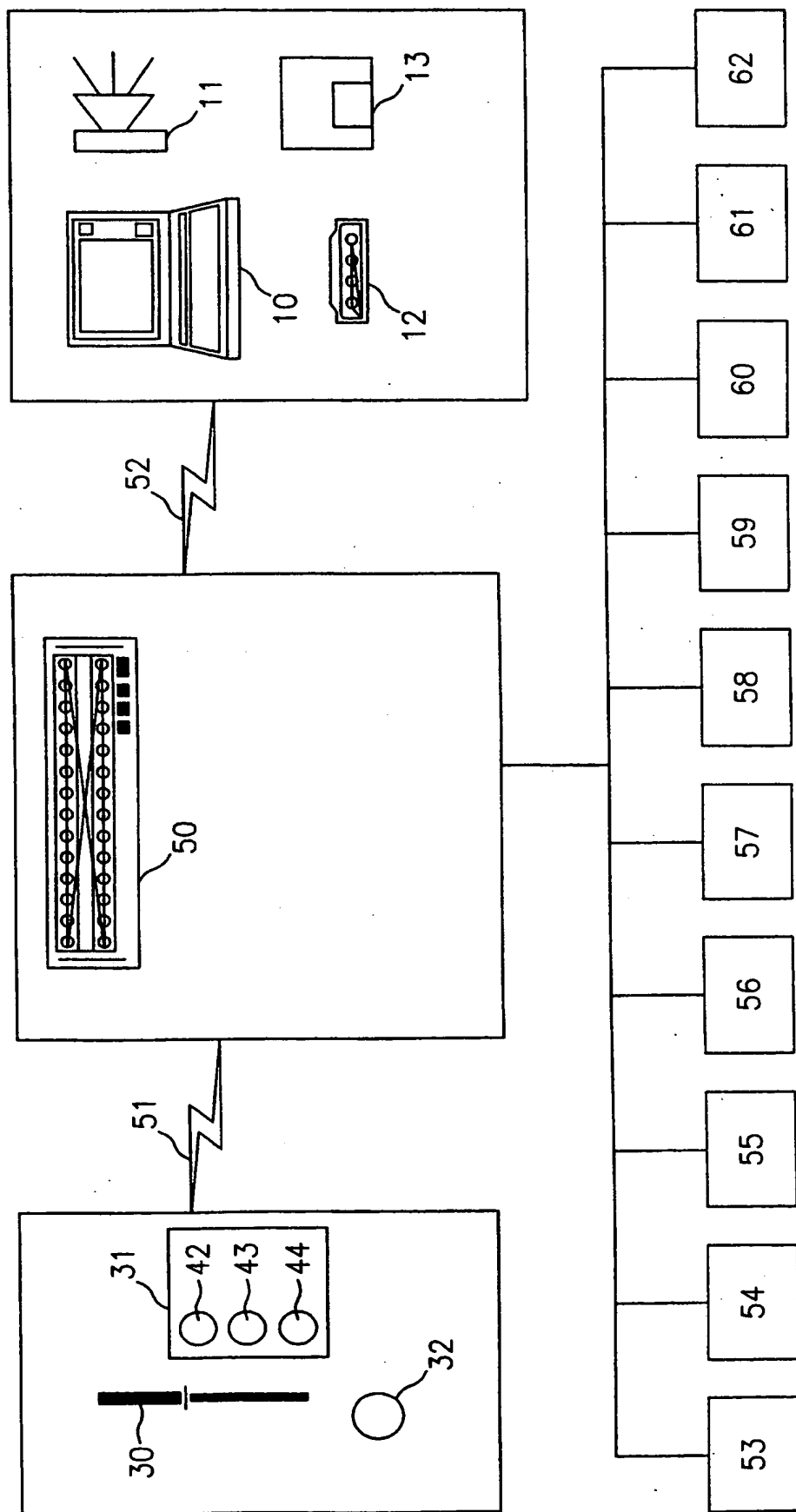


FIG. 5

6/10

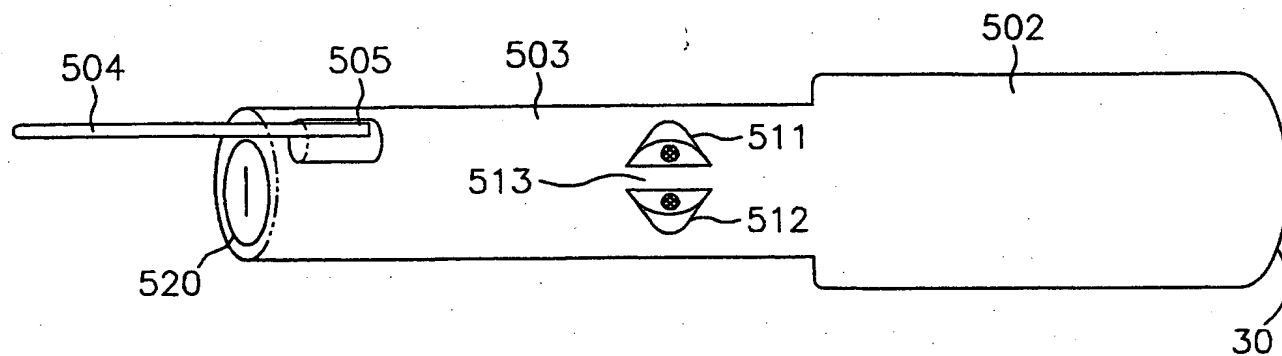


FIG. 6

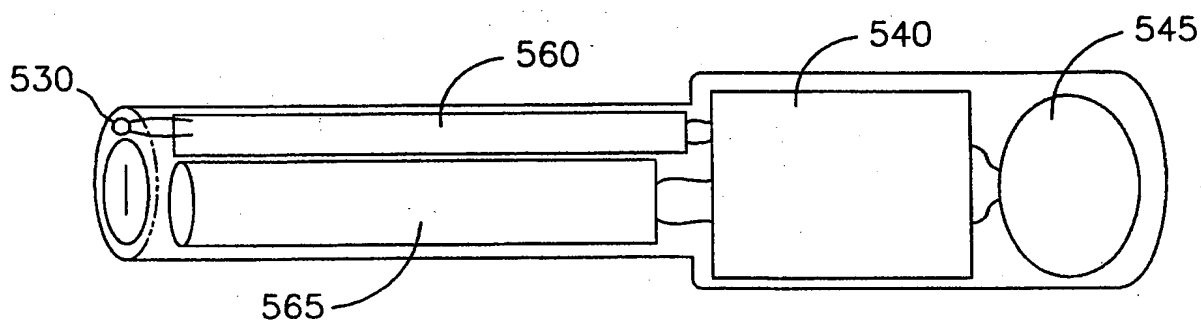


FIG. 7

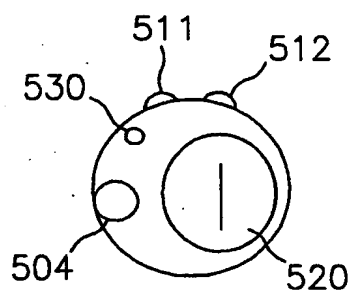


FIG. 8

SUBSTITUTE SHEET (RULE 26)

7/10

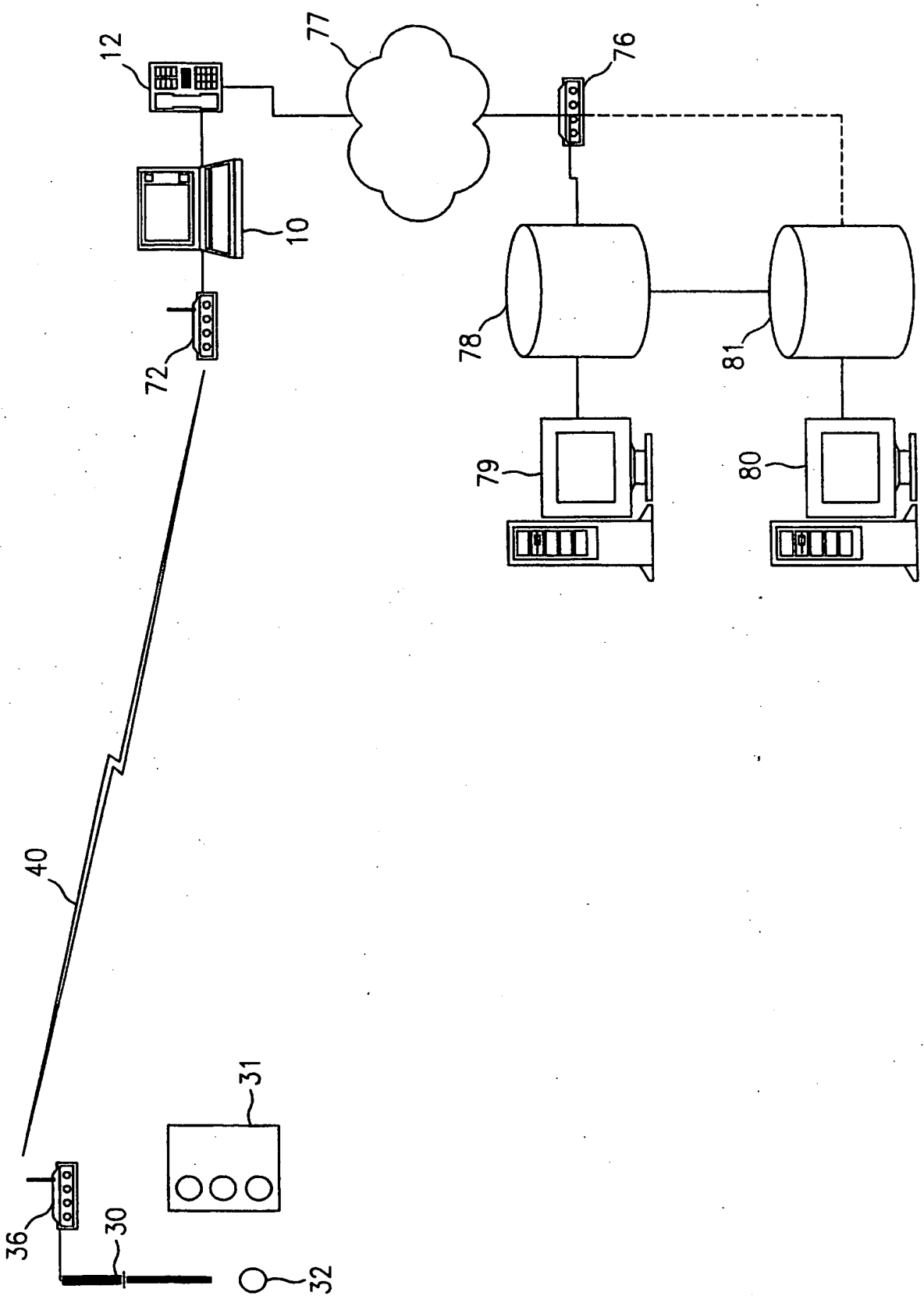


FIG. 9

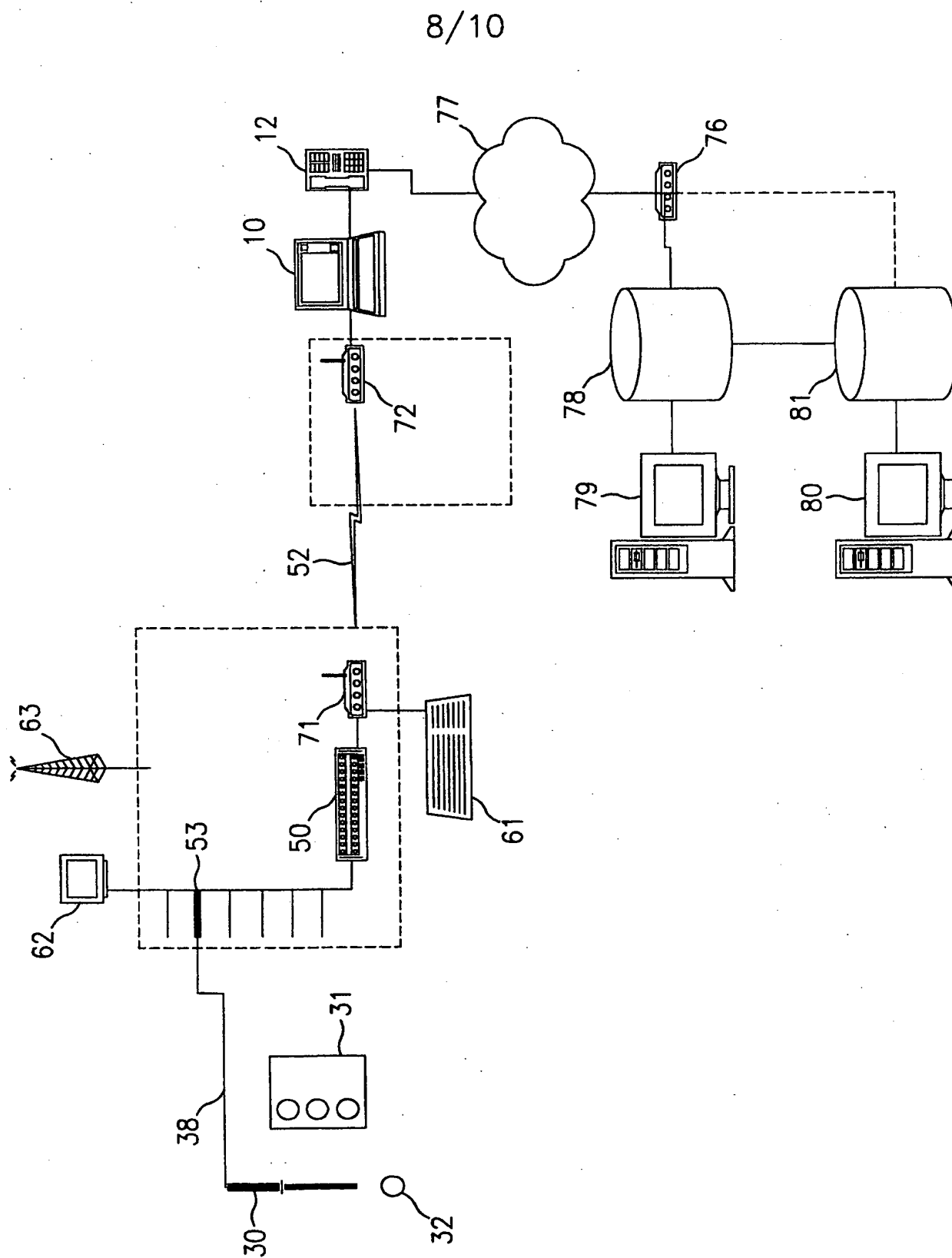


FIG. 10



10/10

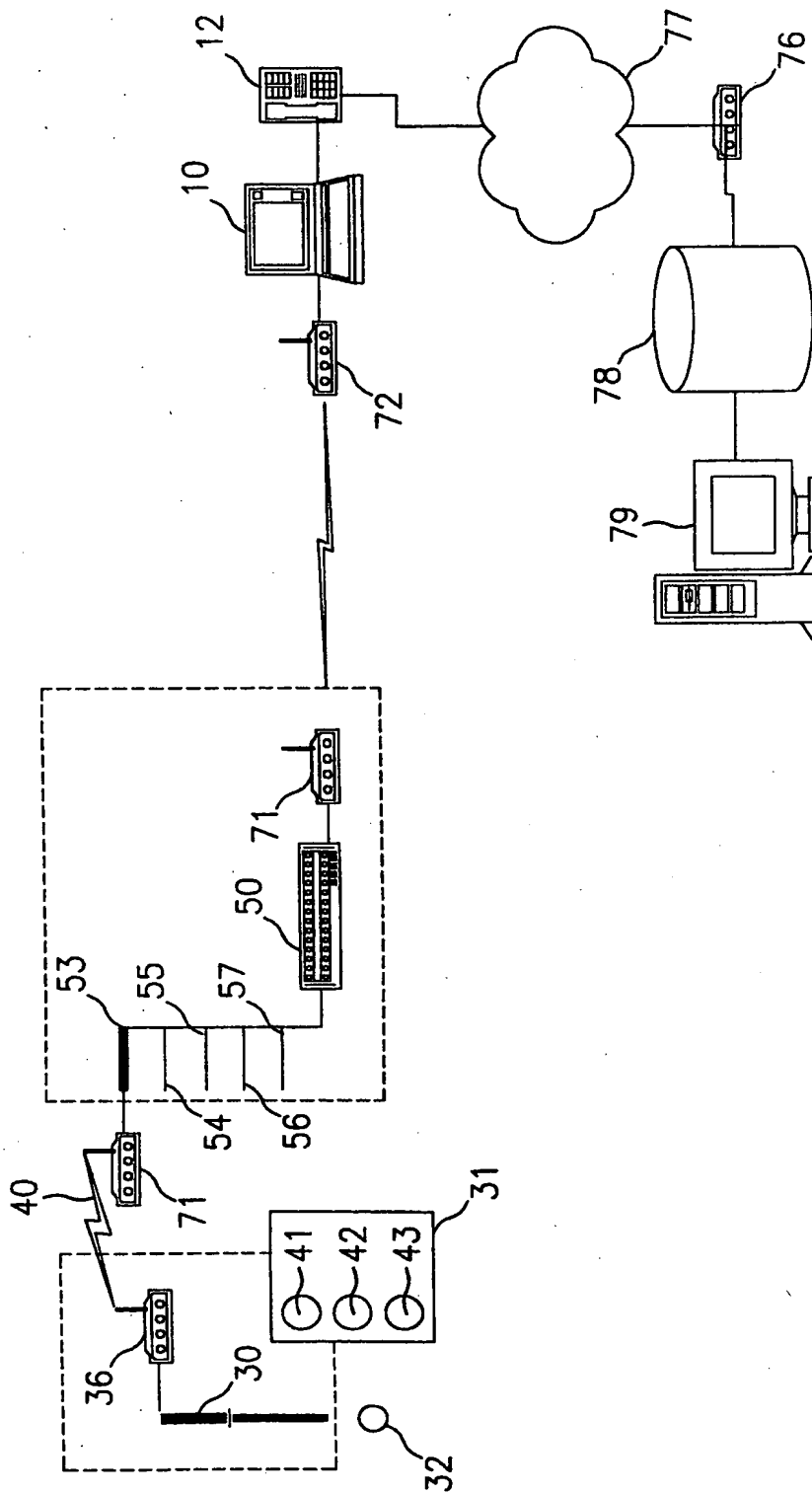


FIG. 12

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 99/05122

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 A01K11/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A01K A22B G07C H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 43740 A (MICRON COMMUNICATIONS INC) 20 November 1997 see page 8, line 11 - line 19; claims 1-4 ---	1-6, 31-39
A	US 5 448 110 A (LAKE RICKIE C ET AL) 5 September 1995 see column 6, line 11 - column 8, line 30; figures ---	40-42, 45-48
A	US 5 235 326 A (MALM ROBERT E ET AL) 10 August 1993 cited in the application see the whole document ---	40,45,48
A	US 5 673 647 A (PRATT WILLIAM C) 7 October 1997 cited in the application see claims 1-9; figures 3-5 ---	1,4,31, 39
-/--		



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

22 June 1999

Date of mailing of the international search report

30/06/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Fonts Cavestany, A

# INTERNATIONAL SEARCH REPORT

Int. Application No

PCT/US 99/05122

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 463 353 A (KUZARA JAMES H) 31 July 1984 cited in the application, see claims; figures ---	1
A	US 4 333 072 A (BEIGEL MICHAEL) 1 June 1982 see claims; figures -----	1

# INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 99/05122

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9743740	A	20-11-1997	AU 3063497 A	05-12-1997
US 5448110	A	05-09-1995	US 5779839 A	14-07-1998
			DE 4319878 A	23-12-1993
			JP 2857029 B	10-02-1999
			JP 6123773 A	06-05-1994
			US 5787174 A	28-07-1998
			US 5776278 A	07-07-1998
US 5235326	A	10-08-1993	EP 0688454 A	27-12-1995
			GR 97300010 T	31-05-1997
			WO 9420941 A	15-09-1994
US 5673647	A	07-10-1997	AU 690741 B	30-04-1998
			AU 3457095 A	09-05-1996
			AU 7868898 A	01-10-1998
			CA 2161749 A	01-05-1996
US 4463353	A	31-07-1984	US 4532892 A	06-08-1985
US 4333072	A	01-06-1982	NONE	

**THIS PAGE BLANK (USPTO)**